SURFACE COVERING

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims benefit of and priority from United States Provisional Application 60/465,351 filed 25 April, 2003; United States Provisional Application 60/507,023 filed 29 September, 2003; and United States Provisional Application 60/507,450 filed 30 September, 2003. The contents of all such priority applications are hereby incorporated by reference herein in their entirety.

FIELD OF THE INVENTION

The present invention relates to surface coverings and more particularly to systems incorporating one or more surface covering elements adapted for installation across a supporting surface and incorporating a backing at least partially coated with a composition adapted to enhance the coefficient of sliding friction relative to the supporting surface. Constructions of various modular surface coverings and methods of formation and installation are also provided.

BACKGROUND OF THE INVENTION

In the past, installation of surface coverings for floors, walls, counter tops, and the like was carried out primarily by professional installers utilizing natural or man-made surface covering materials disposed in a substantially permanent relation over a support surface. Such installation has used constructions and techniques designed to provide firm vertical attachment between the surface covering and the support surface. Such exemplary prior art constructions have included wood plank flooring nailed or adhesively bonded to the sub-floor support surface, carpet and carpet tile tacked or adhesively bonded in place over the sub-floor support surface, ceramic tile held by mortar to the support surface, and the like.

Recently, a trend has developed promoting decorative covering systems which

may be quickly installed and removed. Thus, a number of products have been developed which promote ease of installation. In a number of such systems installation is simplified by elimination of the firm vertical attachment between the covering elements and the underlying surface. However, by eliminating the firm vertical attachment mechanism, the possibility of slippage between the support surface and the covering element is increased.

SUMMARY OF THE PRESENT INVENTION

The present invention provides advantages and alternatives over the prior art by providing surface coverings adapted for installation over a support surface and which include a friction enhancing composition disposed across at least a portion of the underside of the surface covering. The friction enhancing composition is substantially non-blocking such that it does not permanently stick to itself. The friction enhancing composition preferably provides a relatively light releasable tacky adhesion to the support surface but does not permanently stick to the support surface. However, the friction enhancing composition does provide substantial resistance to sliding friction between the surface covering and the underlying support surface.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings which are incorporated in and which constitute a part of this specification illustrate various exemplary embodiments of the present invention and together with the detailed description set forth below serve to explain the principles of the invention wherein:

FIGS. 1-12 are top view illustrations of exemplary geometries and patterning arrangements for surface covering elements across a supporting surface;

FIGS. 13A-23F are cut-away side view illustrations of various exemplary multi-layered constructions for pile-forming surface covering elements for disposition

across a sub-floor support surface each of which incorporates a coating of friction-enhancing composition across an underside surface;

FIGS. 24-24B are cut-away side view illustrations of various decorative covering elements incorporating a non-woven show surface and a friction enhancing coating;

FIGS. 25-25B are cut-away side view illustrations of various decorative covering elements incorporating a flat woven or knit show surface and a friction enhancing back coating;

FIGS. 26-26A are cut-away side view illustrations of various decorative covering elements incorporating a raised pile show surface and a friction enhancing back coating;

FIG. 27 is a cut-away side view illustration of a decorative covering element having a wood show surface;

FIG. 28 is a cut-away side view illustration of a decorative covering element having a ceramic show surface;

FIG. 29 is a cut-away side illustration of a decorative covering element having a synthetic laminate show surface; and

FIG. 30 is an elevation view of an area rug;

FIG. 31 is a cross-sectional view taken along line 31-31 in FIG. 30; and

FIGS. 32 – 36 illustrate various exemplary discontinuous patterns of friction-enhancing materials disposed across the underside of a surface-covering element.

DESCRIPTION OF PREFERRED EMBODIMENTS

Exemplary embodiments of the present invention will now be described by reference to the accompanying drawings, in which, to the extent possible, like reference numerals are used to designate like components in the various views. In FIG. 1, an exemplary system is shown schematically in which a multiplicity of modular surface covering elements 10 are arranged in edge to edge relation across a supporting surface 11. As will be appreciated, the surface 11 may comprise any surface suitable to provide support beneath the surface covering elements 10. By way of example only, materials forming the surface 11 may include plywood, drywall, wood particle board, hardwood, concrete, tile, ceramic tile, vinyl, laminate, glass, or metal such as aluminum, steel or the like. The surface 11 may define a sub-floor, wall, counter top or other surface to be covered by the surface covering elements. In particular, it is contemplated that the surface 11 may be a raised access floor having displaceable panels for access to underlying wiring and cables. As will be appreciated, while a multiplicity of surface covering elements 10 are illustrated as covering the underlying surface, it is likewise contemplated that a single element such as a piece of board loom carpet, area rug or the like may be used.

Regardless of the support surface being covered, it is contemplated that the surface covering elements will preferably provide an aesthetically pleasing coordinated covering. Moreover, it is desired that the individual surface covering elements should be readily removable after initial placement across the subfloor so as to permit repositioning and/or subsequent replacement as desired. In addition, the individual surface covering elements may impart a degree of cushioning across the surface of the subfloor being covered. Such cushioning may be particularly desirable for floor covering installations in residential environments where comfort may be at a premium.

By way of example only, FIGS. 2 – 12 provide schematic representations of at least partial installations, rugs or layouts of different shaped surface covering

elements. In particular, FIG. 2 illustrates an arrangement of substantially square surface covering elements 10 arranged in offset relation. It is believed that the use of such offset placement may in some instances tend to break up the perceived continuity of the seams between the surface covering elements. As will be appreciated, the surface covering elements need not be square. Thus, in FIG. 3, there is illustrated an arrangement of substantially elongate surface covering elements 10A of generally rectangular configuration. By way of example only, it is contemplated that such an arrangement may be particularly useful in the event that the surface covering elements are supplied in a roll form or are intended to simulate wood planking.

Aside from straight sided quadrilateral geometries, it is also contemplated that any number of other geometries including multisided polygonal geometries may also be used. It is believed that the abutting relation of angled edges may provide a dual benefit of facilitating proper installation across the support surface while also tending to break up the perceived continuity of the seams between the surface covering elements.

FIGS. 4 and 5 illustrate arrangements of one exemplary geometry for a surface covering element 10B having a double chevron on each of two opposing sides (preferably the upper and lower edges) and with the remaining two opposing sides being straight and parallel. As shown, such surface covering elements may be installed in either substantially aligned or staggered relation across a support surface. The double chevrons on opposite sides of the tile are preferably complements of one another (i.e. they fit with an adjacent or abutting tile) such that on one side the chevrons are external chevrons which protrude outwardly in a generally convex orientation while on the other side the chevrons are internal chevrons which are recessed in a generally concave orientation.

Of course, it is to be appreciated that any number of other geometric configurations may also be used in formation of the surface covering elements. By way of example only and not limitation, FIG. 6 illustrates rectangular surface

covering elements 10C with a single chevron on two opposing sides or ends. FIG. 7 shows rectangular surface covering elements 10D with multiple (triple) chevrons on two opposing sides or ends. FIG. 8 shows surface covering elements 10E with a single chevron on four sides thereof, wherein the opposing chevrons are respective external and internal chevrons. FIG. 9 shows an arrangement of surface covering elements 10F having a single lobe or curved element on four sides thereof. FIG. 10 illustrates a plurality of triangular shaped surface covering elements 10G arranged in an offset pattern. FIG. 11 illustrates a plurality of diamond shaped surface covering elements 10H arranged in an offset pattern. FIG. 12 illustrates a plurality of hexagonal surface covering elements 10I.

According to the illustrated practice, each of the modular surface covering elements is substantially identical in configuration to other surface covering elements disposed across the support surface. Such uniformity of geometry is believed to substantially reduce the complexity of installation which may be useful to users without substantial experience in the installation of flooring systems. According to a potentially preferred practice in installation, it is contemplated that each of the full tiles of an installation would preferably be of substantially identical shape or configuration while partial tiles used to fill out the edges of the installation may be manufactured as separate edge tiles or cut from full tiles.

It is contemplated that the surface covering elements may have either a substantially flat outer or upper face or a substantially three-dimensional outer face. Various exemplary constructions of both two-dimensional and three-dimensional face structures are set forth more fully hereinafter.

According to one contemplated practice, the surface covering elements disposed across the support surface are multi-layer cushioned or hard back composite carpet tile structures including a plurality of yarns defining an outer face projecting away from the support surface. The yarns are tufted or bonded in place relative to a backing structure of cushioned or hard back construction. The backing structure distributes loads applied across the surface covering element and provides

dimensional stability to the structure covering element such that shape is maintained over time. If desired, the supporting backing structure may include one or more layers of a cushioning material such as foam or the like to further enhance comfort during use.

Referring to FIGS. 13A, 13B, 13C, 13D exemplary constructions of multi-layer cushion backed pile-forming surface covering elements for use in overlaying relation to a subfloor support surface 111 are provided. As illustrated, constructions 110A, 110B, 110C 110D as may be used in surface covering elements of any of the previously described geometries each incorporate a layered arrangement of a pile forming primary pile fabric 112 in overlying relation to a load distributing layer 157 which in turn is disposed in overlying relation to a layer of cushioning material 178, such as virgin foam, or rebonded foam or compressed particle foam which may include an optional backing layer 170 of felt or the like. The underside of each construction includes a friction enhancing coating 180 (either continuous or patterned) adapted to engage the support surface 111. The friction enhancing coating 180 enhances lateral grip without permanently bonding to the support surface 111.

The cushioned constructions illustrated in FIGS. 13A, 13B, 13C, 13D include a load distributing layer 157. The load distributing layer 157 may include a sheet of reinforcement material 158 such as glass or the like in combination with a tie coat material 160 such as a thermoplastic adhesive or thermoset adhesive, preferably a hot melt adhesive or the like to establish a bonding relationship between the primary pile fabric 112 and any underlying cushioning material 178. It is also contemplated that the load distributing layer may be substantially free of any reinforcement material if desired. That is, the load distribution layer 157 may be formed substantially entirely of one or more layers of tie coat material 160.

It is contemplated that the primary pile fabric 112 may incorporate either a tufted or a bonded configuration (with loop and/or cut pile) as will be well known. It is also contemplated that the primary pile fabric 112 may take on any number of

other pile forming constructions including by way of example only and not limitation, textured or flat fabrics having woven, knit, or non-woven constructions.

According to one contemplated practice, the primary pile fabric 112 includes a plurality of pile-forming yarns projecting outwardly from one side of a primary base. If the primary pile fabric 112 used in the present invention is a tufted construction as illustrated in FIGS. 13A, 13B and 13D, the primary base is preferably made up of a primary backing 122 and an adhesive pre-coat 124 such as latex or the like. As will be appreciated, the constructions illustrated in FIGS. 13A and 13B are identical except that the pile forming yarns 121 of the embodiment shown in FIG. 13B have undergone a tip shearing or loop cutting operation to yield a cut pile construction. The construction illustrated in FIG. 13D is, in turn, substantially identical to that of FIG. 13B but incorporating pile yarns 121' of a high twist construction such as a frieze construction or the like which imparts substantial kink to the yarns.

In the illustrated bonded surface construction 110C (FIG. 13C), the primary pile fabric 112 includes a plurality of cut pile yarns 134 implanted in an adhesive 136 such as a latex or hot melt adhesive which is laminated to a reinforcement or substrate layer 138 of a woven or non-woven material including fiberglass, nylon, polyester or polypropylene. It is contemplated that this substrate layer 138 may be pre-coated with latex or other thermoplastic or thermoset materials or polymers to permit melting adhesion with the cut pile yarns 134 upon the application of heat, thereby enhancing yarn stability.

Although certain embodiments may be preferred, it is to be understood that the primary pile fabric 112 may have different embodiments, and the component structure of the primary carpet fabric 112 is not limited. Rather it is intended that any suitable primary pile fabric having a pile forming portion and a primary base or backing may be utilized as the primary pile fabric. By "primary base" is meant any single layer or composite structure including, inter alia, the commonly used layered composite of primary backing 122 and latex pre-coat 124 typically used in

tufted carpet constructions and the adhesive layer 136 with reinforcement substrate 138 typically used in bonded constructions. Other embodiments as may occur to those of skill in the art may, of course, also be utilized. For example, in the bonded product, the pile forming yarns can be heat tacked to the substrate 138 as described in U. S. Patent No. 5,443,881 (hereby incorporated by reference herein) to permit simplified construction of a primary carpet. Alternative embodiments including those disclosed in U.S. Pat. No. 4,576,665 to Machell (incorporated by reference) may likewise be utilized.

In accordance with a contemplated practice, the pile yarn 120, 121, 121' or 134 of constructions 110A, 110B, 110C and 110D, respectively, is capable of being dyed or printed, such as jet dyed, flood dyed, rotary printed, or the like, by, for example, using a Millitron® jet dye machine marketed by Milliken & Company of LaGrange, Georgia. Also, it is contemplated that the complete construction 110A, 110B, 110C, 110D of FIGS. 13A – 13D are capable of being jet dyed, rotary printed, or the like. For example, the exemplary construction used to form the surface covering elements are preferably capable of withstanding the rigors of a jet dye process including dyeing, steaming, washing, drying, and the like. Consequently, the surface covering elements can withstand heat and humidity changes, and the yarn can be dyed or printed. For example, the yarn may be white, light colored, such as off white or light beige, yarn dyed, solution dyed, or the like.

In accordance with at least one embodiment, it is contemplated to add an anti-bacterial, anti-fungal or anti-microbial agent, such as ALPHASAN™ silver based antimicrobial agent marketed by Milliken & Company of Spartanburg, South Carolina, to the latex pre-coat layer and/or to the face yarn, primary backing, tie-coat layer, reinforcement material, foam or cushion, backing, and/or friction enhancing coating or grip layer 180. The ALPHASAN™ silver based anti-microbial agent can withstand heat during processing. It is also contemplated that the face yarn may be subjected to a stain resist agent such as SCOTCH GUARD ® or the like.

The yarns 120, 121, 121' and 134 may be made of natural and/or synthetic fibers and may be either spun, staple or filament yarns and are preferably formed from a polyamide polymer such as nylon 6 staple, nylon 6 filament, nylon 6,6 staple, or nylon 6,6 filament, available from commercial sources such as DuPont in Wilmington, Delaware and Solutia Fibers of St. Louis, Missouri. However, other suitable natural or synthetic yarns or blends may likewise be employed as will be recognized by those of skill in the art. By way of example only and not limitation, other materials, which might be used, include polyester staple or filament, polyethylene terephthalate (PET), and polybutylene terephthalate (PBT), polyolefins, such as polyethylene and polypropylene staple or filament, rayon, polyvinyl polymers such as polyacrylonitrile, wool, and blends thereof. A variety of deniers, plies, twist levels, air entanglement, and heatset characteristics can be used to construct the yarn.

Although it may be preferred that the yarn (or fiber) be a white or light color to facilitate injection dyeing or printing thereof, it is to be understood that the yarn may be of any nature and color such as solution dyed, naturally colored, and the like, and be adapted for dye injection printing, screen printing, transfer printing, graphics tufting, weaving, knitting, and/or the like.

According to one embodiment, the weight of the yarn within the primary pile fabric will be about 10 ounces per square yard to about 75 ounces per square yard and will more preferably be about 20 ounces per square yard to about 60 ounces per square yard and will most preferably be about 30 - 50 ounces per square yard.

In accordance with a contemplated construction illustrated in FIG. 13D, the primary pile fabric may have a face construction such as a frieze cut pile, a saxony cut pile, a loop pile, a Berber loop pile, or the like. Such constructions provide bulk through the pile due to the fact that the terminal ends of the individual pile yarns are kinked such that the extended length of the yarns actually exceeds the pile height. This bulking gives rise to enhanced compressibility in the thickness dimension of the surface covering element. Such enhanced compressibility is believed to correlate to a generally cushioned feel by a user.

As will be appreciated, the desired depth and population density of pile forming yarns across a surface covering element may differ depending upon the intended environment of use. In particular, it is believed that a deeper less populous pile construction may be desired if the surface covering elements are to be used in covering relation to a floor in a residential environment such as a user's home. Conversely, shorter pile which is packed closer together may be desired if the surface covering elements are to be used in a commercial environment such as an office, a hospitality environment such as a hotel, or an institutional environment such as schools or hospitals.

The primary backing 122 used in the tufted constructions of FIGS. 13A, 13B and 13D may be a traditional woven or nonwoven structure of polyester or polypropylene. However, it is also contemplated that specialized primary backings such as non-woven structures comprising fiberglass sandwiched between layers of polyester may be utilized in the primary backing 122 of the tufted constructions to impart the desired properties relating to stability and cutability thereby potentially reducing or even eliminating the need for adhesive pre-coat 124. Alternative primary backing or tufting substrate embodiments are described, for example, in pending U.S. Patent Application Serial No. 10/098,053, filed March 12, 2002 the teachings of which are hereby incorporated by reference in their entirety as if fully set forth herein. It is to be understood that in the event that a nonwoven structure is used in the primary backing, such nonwoven materials can be made in any number of ways. By way of example, it is contemplated that nonwoven materials may be formed by suitable mechanical, chemical or thermal processing techniques. Suitable mechanical techniques may include hydro-entangling, stitch bonding, and needle punching. Suitable chemical and thermal processing techniques may include melt spinning and like practices.

By way of example only and not limitation, according to one contemplated practice, the primary backing 122 is a fused multi-component structure of a woven layer and a non-woven material needle punched through the woven layer, with at

least a portion of the non-woven material being a low melt or binder material which when subjected to calendaring (pressure and heat) melts and fuses the non-woven and woven materials to form an enhanced stability primary backing. The woven layer is a woven polypropylene, the non-woven material is polyester, and the low melt material is low melt or co-polyester. The weight percent range of low-melt or binder material may range from about 10% - 100% by weight of the non-woven, preferably 10% - 70%, most preferably 10% - 40%. The non-woven material may be any natural or synthetic fiber or blend thereof. For example, the non-woven may be polyester, recycled polyester, polypropylene, stabilized polypropylene, acrylic, nylon (polyamide), bi-component polyester, bi-component nylon, and blends or combinations thereof. If the non-woven material is a polypropylene or stabilized polypropylene, then no additional low melt material may be required. The low melt material may be any synthetic material or fiber or blend that has a melting point below the calendaring temperature and will adhere to the adjacent fibers. For example, the binder or low melt material may be polyester, co-polyester, polypropylene, polypropylene that has been chemically enhanced to raise the melt temperature, bi-component polyester, bi-component nylon, polyethylene, nylon, low melt nylon web, powder binder, chemical binder, extruded polypropylene web, and combinations or blends thereof. The woven material may be any natural or synthetic material or fiber or blend which serves as a tufting base in combination with the non-woven and low melt materials. For example, the woven material may be polypropylene, stabilized polypropylene, flat ribbon yarn (tape) polypropylene, polyester, polyester knitted scrim, polypropylene woven scrim, recycled polyester, and blends or combinations thereof. In accordance with one exemplary construction, the woven layer or material may have a pick range of from about 6 X 6 to 30 X 30, preferably from about 10 X 10 to 24 X 22, the non-woven material may have a weight range of about 1 – 6 oz./sq. yd., with a low melt or binder content of about 10 – 100% by weight.

In accordance with one exemplary practice, an enhanced primary backing 122 having an overall thickness of about 0.017 inches and weight of about 5.03 oz./sq. yd. may be utilized. The primary backing includes a woven material fused to a

blended needled non-woven material of polyester and low-melt polyester fibers (50% by weight natural polyester fibers 2-1/2 denier, 20% black polyester fibers 4 denier, and 30% low melt polyester 3 denier). The primary backing is formed by placing the non-woven material over the woven layer, needle punching the non-woven material to the woven layer such that a small amount of the non-woven goes through the woven layer and then calendaring the composite on both sides (at a temperature of about 320°F top roller, 280°F bottom roller with roller pressures of about 85 pounds force) force to fuse the non-woven material and woven layer. This fused, enhanced stability primary backing is less likely to fray when cut, does not harm the tufting yarn, provides dimensional stability, and better tuft lock.

In accordance with yet another exemplary practice, an enhanced primary backing includes a woven scrim and nonwoven fiber needled and then fused in accordance with the following:

Scrim: woven polypropylene (PP) 24 ends by 11 picks @ 3oz.

Weight of Nonwoven: 1.75 oz./sq. yd.

Nonwoven content:

30% low melt polyester (PET) – 4 denier; 2" staple length

50% natural PET – 2.25 denier; 3" staple length

20% black PET – 4.0 denier; 4" staple length

Calendar temperatures:

Face: 320 F

Back: 280 F

In tufted constructions, the adhesive pre-coat 124 is preferably styrene butadiene rubber (SBR) or latex but other suitable materials such as styrene acrylate, polyvinyl chloride (PVC), ethylene vinyl acetate (EVA), acrylic, and hot melt adhesives such as bitumen, polyurethane, polyester, polyamide, EVA, or asphalt based hot melt adhesives or blends thereof may likewise be utilized. In the event that a hot melt adhesive is utilized, it is contemplated that a reinforcement material such as a fiberglass, nylon or polyester scrim, woven or non-woven may be

directly attached to form a composite laminate without the use of additional adhesive layers. Moreover, it is contemplated that the adhesive pre-coat 124 may be entirely eliminated in the tufted product if the pile yarn is tufted in suitably stable relation to the primary backing 122 thereby yielding a construction as illustrated in FIGS. 15A -15C.

As previously indicated, it is contemplated that a cushion backed surface covering element construction including either a tufted or a bonded primary pile fabric 112 across the surface facing away from the subfloor 111 may include a load distribution layer 157 at a position below the primary pile fabric. By way of example only, it is contemplated that the load distribution layer 157 may include one or more layers of a resilient polymeric tie coat material 160. The polymeric tie coat material 160 may be of either a thermoplastic or a thermosetting composition. Hot melt adhesives may be particularly preferred. By way of example only and not limitation, useful hot melts may include bitumen and polyolefin-based thermoplastics. Useful thermosetting adhesives may include polyurethanes. In the event that the tie coat material 160 is a hot melt adhesive, it is contemplated that the total mass of hot melt adhesive utilized within the load distribution layer 157 will preferably be in the range of about 20 to about 100 ounces per square yard and will more preferably be present at a level of about 35 to about 90 ounces per square yard. The composition of one potentially preferred hot melt adhesive is set forth in the following table.

Hot Melt Composition

Component	**Percentage**
Asphalt	17.6%
Stearic Acid	0.3%
Heat Stabilizer	0.2%
Antioxidant	0.1%
Tackifier	3.0%
Amorphous Polypropylene	4.0%
Acid Modified Polypropylene	2.0%
Calcium Carbonate Filler	Remainder

The physical properties of the hot melt composition from the above table are set forth below.

Hot Melt Properties

Softening Point	314-320°F
Cold Flow	2 to 5 mils per 4 hours
Flex Mandrel	12 to 16 mm at 76 mils
CR Viscosity (at $5sec^{-1}$)	28,000 to 35,000 cps
CS Viscosity (at 50Tau)	10,000 to 13,000 cps
Tensile Strength	~450 p.s.i.
Elongation at Break	5.8%

If desired, a reinforcement material 158 may also be disposed within the load distribution layer 157. In some constructions, the reinforcement material may enhance dimensional stability within the surface covering element to substantially prevent the various layers from undergoing disproportionate dimensional change as the surface covering element is subjected to compressive forces and/or temperature or humidity changes during use and/or processing. One contemplated reinforcement material 158 is a sheet, mat or tissue incorporating multiple fiberglass (glass) fibers entangled in a non-woven construction such as a 2 oz/yd^2 construction and may be held together by one or more binders such as an acrylic binder or modified acrylic binder. Other materials as may be utilized include woven glass or glass scrim materials as well as woven or non-woven textile materials such as polyester or nylon. If desired, it is also contemplated that the reinforcement material 158 may be eliminated such that the load distribution layer is made up substantially entirely of the tie coat material.

Whether or not a reinforcement material 158 is utilized, the load distribution layer 157 nonetheless acts to disperse concentrated loads laterally through the surface covering element thereby dissipating the applied energy and preventing the structure from being damaged. In operation, the tie coat material 160 acts as a buffer against force concentration and will protect any reinforcement material 158 against puncture or other damage which may arise from point loading. By way of

example, the load distribution layer must have sufficient strength and resiliency such that a small diameter shoe heel or other force concentrating object does not puncture the construction.

As indicated, the cushioning material 178 may be a foam material. Potentially preferred foam materials may include virgin or prime polyurethane, rebonded polyurethane and combinations thereof. Rebonded polyurethane may be particularly preferred so as to permit the surface covering elements to incorporate a relatively high percentage of recycled material.

As will be appreciated, rebond foam in general and rebond polyurethane foam in particular is known in the art of isocyanate-based polymeric foams. Specifically, it is known to mix pieces of foam with a binder which serves to bond the pieces to one another. Rebonding technology has been used for a number of years to recycle, inter alia, polyurethane foams. Generally, a large chip or chunk size, low density, non-uniform density, rather frangible, thick, rebonded polyurethane foam product has been used as a separate, relatively thick, underlayment or pad for broadloom carpet placed across a subfloor.

In accordance with one contemplated practice, the cushioning material 178 in the surface covering element may incorporate about 10-90% recycled foam or rebond foam containing about 10-100% recycled foam chips, chunks, pieces, grounds, particles, or the like and a binder, adhesive, or prepolymer (and one or more additives) to produce a construction with an integral cushioning layer having about 10-100% recycled foam or cushion content (especially post industrial reclaimed foam or cushion content) in the foam or cushion layer thereof.

In accordance with one contemplated practice, the cushioning material may be a rebond foam with a density of about 1 to 25 lbs per cubic foot, more preferably about 3-22 lbs. per cubic foot, still more preferably 5-13 lbs. per cubic foot, and most preferably 6 – 10 lbs. per cubic foot; a thickness of about 1-30 mm, more preferably about 2 – 21 mm, and most preferably about 4 – 12 mm; a rebond chip

size (uncompressed chip size) of about 2-25 mm, more preferably about 5-20 mm, most preferably about 7-15 mm round or square hole mesh; and, a backing material or backing composite on at least one side thereof.

Table 1 below details a first exemplary range of production parameters for rebond foam for use as a cushioning layer in a modular floor covering to be used in a residential environment.

Table 1

Foam Weight	7 – 84 oz/yd^2
Foam Density	4 – 16 lbs./ft^3
Foam Thickness (prelamination)	2 – 20 mm
Uncompressed Chip Size	2 – 20 mm
Chip Material	Polyurethane Foam (polyester or polyether)
Binder or Prepolymer	5 – 20%
Chips	60 – 95%
Binder Material	Polyurethane Prepolymer (polyester or polyether)
Compression Ratio	2:1 – 5:1
Additives such as colorant, fill, fiber, antimicrobial, flame retardant, etc.	0-20%

Table 2 below details a second exemplary range of production parameters for rebond foam for use as a cushioning layer in a modular floor covering to be used in a residential environment.

Table 2

Foam Weight	10 – 28 oz/yd^2
Foam Density	5 – 10 lbs./ft^3
Foam Thickness (prelamination)	5 – 12 mm
Uncompressed Chip Size	5 – 15 mm
Chip Material	Polyurethane Foam (polyester or polyether)
Binder or Prepolymer	12 – 17%
Chips	83 – 88%
Binder Material	Polyurethane Prepolymer (polyester or polyether)
Compression Ratio	3:1
Additives such as colorant, fill, fiber, etc.	0-5%

Tables 3-5 set forth exemplary target specifications for rebond foam materials which may be used in various modular residential floor covering structures.

Table 3

Foam Density	6 lbs./ft^3
Foam Thickness (prelamination)	7 - 8 mm
Uncompressed Chip Size	15 mm
Chip Material	Polyurethane Foam
Binder or Prepolymer	15% by weight
Chips	82-85% by weight
Binder Material	Polyurethane Prepolymer
Compression Ratio	3:1
Colorant (may be added)	Milliken Reactint polyurethane colorant at about 3%

Table 4

Foam Density	6.3 lbs./ft^3
Foam Thickness (prelamination)	7 mm
Uncompressed Chip Size	7 mm
Chip Material	Polyurethane Foam
Binder or Prepolymer	15% by weight
Chips (free of unbonded material)	82-85% by weight
Binder Material (free of binder knots)	Polyurethane Prepolymer
Compression Ratio	3:1
Colorant (may be added)	Milliken Reactint polyurethane colorant at about 3%

Table 5

Foam Density	3 lbs./ft^3
Foam Thickness (prelamination)	6 mm
Uncompressed Chip Size	5 mm
Chip Material	Polyurethane Foam
Binder or Prepolymer	15%
Chips	82-85%
Binder Material	Polyurethane Prepolymer
Compression Ratio	2:1
Colorant (may be added)	Milliken Reactint polyurethane colorant at about 3%

As will be appreciated, while rebond foam as described above may be used, it is also contemplated that the material forming the cushioning layer 178 may be the subject of a broad range of alternatives. By way of example only and not limitation, at least five options or examples of foam for use in forming the cushion material 178 are contemplated for forming the surface covering elements.

1. Use of standard filled Polyurethane system as the virgin and/or rebond polyurethane. One contemplated polyurethane foam contains 110 parts of filler and has a density of about 15 lbs/cu. ft. Based upon a thickness in the range of .04 - .12 inches, using the density and filler levels above, the weight range of the polymer is about 4.32 oz/sq yd to 12.96 oz/sq yd. The density can be lowered by lowering the amount of filler.

2. Another option which would also work for the virgin and/or rebond polyurethane is to adjust the filler levels to reduce the density to 13 lbs/cu. ft. At the same thickness limits the polymer weights would then be 2.72 – 8.24 oz/sq. yd.

3. Another option for the virgin and/or rebond polyurethane is to use an unfilled polyurethane (Prime urethane) system. High densities such as above are not possible with prime however, they perform because of the wall structure and the fact that no filler is present. Based upon a prime at 6 lbs/cu. ft. applied at the thickness limits above the polymer weight would be 2.88 – 8.64 oz/sq. yd.

4. Another option is to use a polyurethane system available under the trade designation KANGAHIDE by Textile Rubber and Chemical Company which has only 15 parts of a filler material and is applied at 6 – 9 lbs/cu. ft. density may be used. If a polymer calculation is again made at the described thickness limits it would be 4.3 – 13.02 oz/sq. yd.

5. Another option is to use a medium density or hybrid foam formed of mechanically frothed and chemically blown polyurethane foams. Such a mechanically frothed and chemically blown polyurethane foam is described, for example, in U.S. Patent No. 6,372,810 hereby incorporated by reference herein.

The density of filled prime or virgin polyurethane foams can be controlled by limiting the amount of filler. For example, one can reduce the filler content to produce a prime polyurethane foam of about 6 lb. per cubic foot density.

Although the above examples have to do with polyurethane, a water based foam system can also be used. For example, the foam may be an SBR foam. Although a virgin polyurethane or polyurethane rebond foam or compressed particle foam (formed of compressible particles, chips, crumbs, etc.) may be preferred, it is to be understood that other compressible particles made from other foams (open cell, closed cell) or materials such as SBR foam, PVC foam, polyethylene foam, cork, rubber, crumb rubber, and/or the like may also be used. In particular, it is contemplated that in place of foam, a felt or non-woven cushion may be utilized.

Regardless of the cushioning material used in the cushioning construction, it is contemplated that such material will preferably be characterized by a compression modulus such that a relatively soft feel is imparted to the user. By way of example only, it is contemplated that the cushioning material will preferably be characterized by a 50% compression at a load of between about 5 and about 70 psi and more preferably about 10 to about 30 psi when the isolated cushioning material is measured according to ASTM specification D3574 Test C (Compression Force Deflection Test).

As previously indicated, surface covering elements of any of the described constructions may include an optional backing layer 170 also referred to as a release layer or secondary backing. The optional backing layer 170 may be a woven or non-woven textile fabric of polyester, polypropylene, polyester/polypropylene, polyester/polypropylene/acrylic, or other appropriate fibers or blends and may contain a colorant, binder, or the like. According to one contemplated practice, the backing layer 170 may be a non-woven structure or felt of polyester fiber and polypropylene fiber, with about 50% - 100% polyester. In another embodiment, a blend of 50% polyester fiber, 20% polypropylene, and 30% acrylic fibers may be used. The polyester, polypropylene and/or acrylic

fibers may be of one or more selected colors to give the backing a desired color or appearance. In one embodiment, foam forming the cushioning layer and the backing layer 170 have a similar color. In a particular example, the foam and/or backing have a green, blue, purple, gray, white, black, brown, or gold color. The color of the backing can be achieved, for example, by using a white polyester fiber and a colored acrylic fiber or by using colored polyester and/or polypropylene fibers. In accordance with another example, an amount of black polyester fibers is blended with an amount of white polyester fibers, an amount of colored polyester fibers, and an amount of white polypropylene fibers to form a non-woven colored backing material or felt having the color of the colored polyester fibers and having a heathered or speckled look. The respective amounts of each type or color of fiber are selected to give the desired color, brightness, shrink, etc.. The surface covering elements of any of the described constructions also preferably include a friction enhancing coating 180 which may be applied in either a substantially continuous or patterned arrangement. By way of example only and not limitation, such friction enhancing coatings may include latex, hot melt adhesives, silicone rubber, other rubbers, and the like. Also, although it is not preferred, the coating 180 may be covered with a release sheet, layer or film.

As will be appreciated, there exist a substantial number of alternative embodiments and configurations for layered constructions forming the surface covering elements for use in the flooring system of the present invention. By way of example only, in FIGS. 14A, 14B, 14C and 14D wherein elements corresponding to those previously described are designated by like reference numerals in a 500 series, pile constructions are illustrated corresponding substantially to those in FIGS. 13A-D respectively but wherein the reinforcing material 558 as previously described is held in suspended relation between layers of tie coat material such as the hot melt adhesive previously described. In such a construction, it is contemplated that the tie coat material 560 may be either in substantially discrete layers separated by the reinforcement material 558 or may migrate across the reinforcement material 558. In either event, due to the substantial adhesion between the tie coat material 560 and the reinforcement

material 558, a substantially stable load distribution layer 557 is nonetheless established in bonding relation between the primary pile fabric 512 and the cushioning material 578.

In accordance with one example and with reference again to FIGS. 14A – 14D, the reinforcement material 558 may be a glass mat which is hot melt laminated to the foam 578 by a hot melt layer 560.

As illustrated in FIGS. 15A, 15B and 15C, wherein like components to those previously described are designated by corresponding reference numerals within a 600 series, it is contemplated that tufted loop pile and tufted cut pile constructions 610A and 610B may include a first layer of tie coat material 660 such as hot melt adhesive or the like extending away from the primary backing 622 and into contact with a sheet of reinforcement material 658 such as the non-woven glass or scrim material previously described. Thus, the tie coat material 660 serves the function of securing the tufts 620, 621 in place relative to the primary backing 622 thereby avoiding the need to utilize a separate latex or hot melt pre-coat. Accordingly, a single adhesive layer extends between the upper surface of the reinforcement material 658 and the underside of the primary backing 622. Of course, if desired a fiction enhancing coating 180 as previously described is disposed across the underside of the backing 670.

As illustrated in FIGS. 16A, 16B and 16C wherein like components to those previously described are designated by corresponding reference numerals within a 700 series, it is contemplated that tufted loop pile construction 710A, tufted cut pile construction 710B, and bonded cut pile construction 710C include a first layer of a tie coat material 760 extending away from the upper surface of a layer of reinforcement material 758 and which may be of a different character from a second layer of tie coat material 760' extending away from the lower surface of the reinforcement material. In all other respects, the configuration is substantially as illustrated and described in relation to FIGS 15A, 15B and 15C respectively. By way of example only and not limitation, in the event that the reinforcement

material 758 is disposed between two different adhesives, it is contemplated that the tie coat material 760 extending away from the upper surface of the reinforcement material 758 may be, for example, hot melt, while the tie coat material 760' extending away from the lower surface of the reinforcement material 758 may be, for example, polyurethane forming composition, a low melt powder, low melt fibers, a low melt film, or the like. Of course, the tie coat material 760 and/or 760' may also comprise multiple layers of the adhesive. A fiction enhancing coating as previously described may be disposed across the underside of the backing 770.

In FIGS. 17A, 17B and 17C wherein like components to those previously described are designated by corresponding reference numerals within an 800 series, there are illustrated yet additional constructions for forming surface covering elements for use in covering a subfloor support surface 811. In such embodiments, tufted loop pile construction 810A and tufted cut pile construction 810B, 810C include a layer of reinforcement material 858 disposed between a first layer of latex adhesive 824 extending away from the upper side of the reinforcement material 858 and a second layer of latex adhesive 824 extending away from the lower side of the reinforcement material 858. Thus, latex extends substantially between the upper surface of the cushion material 878 and the primary backing 822 with the layer of reinforcement material 858 disposed within such latex at an intermediate position. Such latex is preferably a carboxilated styrene butadiene rubber (SBR) latex. Of course it is also contemplated that similar constructions utilizing other adhesives such as Polyvinyl chloride (PVC), ethylene vinyl acetate (EVA), and acrylics as well as hot melts or polyurethanes as previously described may be useful. Of course, if desired a fiction enhancing coating as previously described may be disposed across the underside of the backing 870.

As previously indicated, it is contemplated that additional stability may be introduced by incorporating stabilizing elements in intimate relation to the primary backing of a tufted primary pile fabric. Exemplary embodiments incorporating such

a configuration are illustrated in FIGS. 18A, 18B and 18C wherein like components to those previously described are designated by corresponding reference numerals within a 900 series. As illustrated therein, tufted loop pile construction 910A and tufted cut pile construction 910B, 910C include pile forming yarns 920, 921, 921' tufted through a primary backing 922 which incorporates therein a primary backing stabilizing layer 923 such as a woven or non-woven material or scrim. The primary backing stabilizing layer 923 may be adjoined to the primary backing 922 by a needling or calendaring operation. In addition, point bonding may be achieved between the structures by incorporating heat activated adhesive fibers within the non-woven construction. In the event that a construction incorporating a primary backing stabilizing layer is utilized, it is contemplated that the pre-coat 924 and/or the reinforcement material 958 may be substantially reduced or eliminated entirely if desired due to the stability imparted to the enhanced primary backing 922, 923. A fiction enhancing coating 180 as previously described may be disposed across the underside of the backing 970.

As will be appreciated, while the secondary backing or felt may be flame laminated to the underside of the construction, it is also contemplated that other attachment mechanisms may be used if desired. By way of example only, it is contemplated that the secondary backing may be joined to the underside by one or more layers of adhesive such as hot melt adhesive or the like as previously described. Exemplary cut pile constructions 1010A, 1010B for a surface covering element disposed in overlying relation to a subfloor support surface 1011 are illustrated in FIGS. 19A and 19B, wherein elements corresponding to those previously described are designated by corresponding reference numerals within a 1000 series. As illustrated, in each of those constructions a layer of laminating adhesive 1060 is disposed between the cushioning material 1078 and the secondary backing 1070. However, the secondary backing 1070 may also be flame laminated or otherwise directly attached to the cushioning material if desired.

In accordance with yet another embodiment as shown in FIG. 20, which corresponds to FIG. 13D, and wherein like components are designated by like reference numerals within an 1100 series, the reinforcement material or layer 158 and the precoat layer 124 have been eliminated. Thus, in this embodiment, the tie-coat layer 1160 such as a resilient adhesive extends between the primary carpet 1112 and the cushioning material 1178.

With reference to FIG. 21 which corresponds to FIG. 13D and wherein like components are designated by like reference numerals within an 1200 series, still another embodiment is illustrated in which the backing layer of felt or other material 170 of FIG. 13D has been eliminated.

With reference to FIG. 22 which corresponds substantially to FIG. 18, and wherein like components are designated by like reference numerals within a 1300 series, reinforcement layer 958, and backing layer 970 have been eliminated. The foam layer 1378 may be adhered to the primary carpet fabric, for example, by flame lamination or by being applied directly thereto in a wet or uncured state and then cured. In each of the constructions illustrated in FIGS. 20, 21, and 22 a friction enhancing coating composition 180 is disposed across the underside.

Of course, it is also contemplated that the surface covering elements may be of a so called "hard back" construction which does not incorporate a foam layer. By way of example only, and not limitation, exemplary tufted and bonded constructions which do not incorporate a foam layer are shown in FIGS. 23A – 23F.

In the tufted construction of FIG. 23A, the pile forming yarn 1420A is tufted through a primary backing layer 1422A such as woven or nonwoven glass, spunbonded polyester or the like at a yarn density of about 16-24 ounces per square yard. A layer of precoat 1424A (about 16 ounces per square yard) such as latex or PVC is disposed below the primary backing layer 1422A to a layer of PVC (poly vinyl chloride) or hot melt 1460A. A layer of glass reinforcement (1458) (about 3 ounces per square yard) is disposed between the layer 1460A and

another layer of PVC or hot melt 1461A so as to form a stabilizing sandwich structure. The total combined mass of the first and second layers of PVC or hot melt is preferably about 60 ounces per square yard. A friction enhancing coating composition 180A is disposed across the underside.

The tufted construction 1410B illustrated in FIG. 23B is identical to that illustrated in FIG. 23A but with the addition of a layer of felt 1470B or other surface conforming secondary backing material overlying the friction enhancing coating composition 180B. It is contemplated that such a layer of felt or other surface conforming material may be beneficial in adapting the structure to placement across an irregular underlying support surface.

The tufted construction 1410C illustrated in FIG. 23C illustrates a simplified construction in which a tuft locking precoat layer 1424C such as latex, hot melt adhesive or the like extends away from the primary backing 1422C to the secondary backing 1470C. A friction enhancing coating 180C is disposed across the secondary backing 1470C.

The bonded construction 1410D illustrated in FIG. 23D includes a surface of bonded yarns 1434D having a pile density of about 29 ounces per square yard projecting away from a primary backing layer 1438D of glass having a mass per unit area of about 3 ounces per square yard. While the substrate layer 1438D is illustrated as a nonwoven construction, it is likewise contemplated that the substrate layer 1438D may be a woven construction if desired. As shown, the yarns 1434D are held in place across the substrate layer 1438D by a bonding layer 1436 of PVC or the like. According to one contemplated practice, the bonding layer has a mass per unit area of about 60 ounces per square yard. As illustrated, a first layer of PVC 1460D extends away from the substrate layer 1438D to an upper side of a stabilizing layer 1458D such as woven or nonwoven glass with a second layer of PVC 1461D extending away from the lower side of the stabilizing layer 1458D. According to one contemplated construction the first and second layers of PVC 1458D, 1461D have a total combined mass of about 80

ounces per square yard and the stabilizing layer has a mass per unit area of about 3 ounces per square yard. A friction enhancing coating layer 180D is disposed across the underside of the second layer of PVC 1461D.

The bonded construction 1410E illustrated in FIG. 23E is identical to that illustrated in FIG. 23D but with the addition of a layer of felt 1470E or other surface conforming secondary backing material overlying the friction enhancing coating composition 180. It is contemplated that such a layer of felt or other surface conforming material may be beneficial in adapting the structure to placement across an irregular underlying support surface.

FIG. 23F illustrates a tufted loop pile carpet tile construction 1410F similar to that illustrated in FIG. 23C in which the primary carpet 1412F includes a layer of PVC 1424F extending away from a primary backing 1422F. One such PVC backed hard backed tile primary carpet construction 1412F which is well known is available from Toli Japan and has a weight of about 1320 grams per square meter. The illustrated construction of FIG. 23F modifies such a traditional PVC hard backed construction by adding a friction enhancing coating 180F as will be described further hereinafter which is resistant to PVC plasticizer and additive migration and reaction.

It is also contemplated that a wide range of surface covering element constructions other than pile fabric may be utilized. By way of example only, and not limitation, various other constructions include surface coverings of woven or non-woven fabric (including woven, knit, flocked, and needle punched fabrics and the like) hardwoods, ceramic tile (and veneers emulating hardwoods and ceramic tile), glass, vinyl composite tile, stone (such as marble, granite and the like), slab-like decorative composites such as CORIAN® and the like as well as decorative laminate sheeting such as linoleum and the like.

By way of example only and not limitation, in FIGS 24, 24A and 24B various surface covering constructions are illustrated which incorporate a show fabric

1550 of nonwoven construction with a backing layer of friction enhancing composition 180. As will be appreciated, the constructions in FIGS. 24 and 24A are identical in all respects except that in the construction of FIG. 24A a relatively thin layer of clear covering material 1555 such as polyurethane or the like is disposed across the surface of the show fabric 1550. As will be appreciated, such a construction may provide additional protection against wear while facilitating the ability to roll office furniture and the like across the surface.

In FIG. 24B a cushioned construction is illustrated wherein a cushioning layer 1578 as previously described is incorporated into the construction. As will be appreciated, in these constructions the non-woven show fabric provides a visually desirable visible show surface which is held against lateral slippage by the friction enhancing composition 180.

A set of alternative constructions which utilize a woven or knitted show fabric 1650 is set forth at FIGS. 25, 25A and 25B wherein elements corresponding to those previously described are designated by like reference numerals within a 1600 series. As will be appreciated, in these constructions the woven or knitted show fabric provides a visually desirable visible show surface which is held against lateral slippage by the friction enhancing composition 180. In FIGS 25A and 25B a relatively thin layer of clear covering material 1655 such as polyurethane or the like is disposed across the show fabric 1650.

A set of alternative constructions which utilize a napped woven or knitted show fabric 1750 is set forth at FIGS. 26 and 26A wherein elements corresponding to those previously described are designated by like reference numerals within a 1700 series. As will be appreciated, in these constructions the napped show fabric 1750 provides a visually desirable visible show surface which is held against lateral slippage by the friction enhancing composition 180.

An alternative construction which utilizes a wood or wood veneer show surface 1850 is set forth at FIG. 27 wherein elements corresponding to those previously described are designated by like reference numerals within an 1800 series. As will

be appreciated, in this construction the wood or wood veneer show surface provides a visually desirable visible show surface which is held against lateral slippage by the friction enhancing composition 180. If desired, one or more intermediate layers of felt, foam or combinations thereof may be disposed between the wood or wood veneer show surface 1850 and the friction enhancing composition 180.

An alternative construction which utilizes a show surface 1950 of ceramic, stone, or a composite emulating ceramic or stone is set forth at FIG. 28 wherein elements corresponding to those previously described are designated by like reference numerals within a 1900 series. As will be appreciated, in this construction the show surface 1950 of ceramic, stone, or a composite emulating ceramic or stone provides a visually desirable visible show surface which is held against lateral slippage by the friction enhancing composition 180. If desired, one or more intermediate layers of felt, foam or combinations thereof may be disposed between the show surface 1950 of ceramic, stone, or a composite emulating ceramic or stone and the friction enhancing composition 180.

An alternative construction which utilizes a show surface 2050 of laminate such as linoleum, vinyl composite tile or the like wherein elements corresponding to those previously described are designated by like reference numerals within a 2000 series. As will be appreciated, in this construction the show surface 2050 of synthetic laminate such as linoleum, vinyl composite tile or the like provides a visually desirable visible show surface which is held against lateral slippage by the friction enhancing composition 180. If desired, one or more intermediate layers of felt, foam or combinations thereof may be disposed between the show surface 2050 of laminate such as linoleum, vinyl composite tile or the like and the friction enhancing composition 180.

Of course, it is also contemplated that other constructions such as foam or broadloom carpet with a layer of friction enhancing composition may likewise be utilized as a surface covering element. By way of example only, in FIG. 30 there

is illustrated a surface covering element 2110 in the form of an area rug disposed across a flooring surface 2111.

An exemplary cross section of the area rug 2110 is shown in FIG. 31. In the illustrated construction a pile yarn 2121 is tufted through a primary backing 2122 as previously described and held in place by a precoat layer 2124 of latex or other suitable material as previously described. Of course, it is to be understood that while the pile yarn 2121 is shown as a cut pile, that a loop pile or other construction may likewise be used.

In the illustrated arrangement a secondary backing 2170 is disposed at a position below the precoat layer 2124. The secondary backing is preferably a nonwoven material formed by suitable mechanical, chemical or thermal processing techniques such as a stitch bonded, hydro-entangled or needle punched textile structure. A continuous or discontinuous friction enhancing coating or griping layer 180 is disposed across the underside. A stitch bonded textile may be particularly preferred for the secondary backing 2170. Of course, it is to be understood that such stitch bonded and other nonwoven surface covering materials may be used on surface covering elements other than area rugs including any carpet or carpet tile construction as previously described.

The surface covering elements are preferably suitable for installation by a user with little or no experience with surface covering installations. Depending upon the construction of the surface covering element being used, it is contemplated that covering may take place across virtually any surface including floors, walls countertops and the like. As previously indicated, so as to improve the ease of installation, the surface covering elements disposed across the support surface are preferably resistant to sliding movement across the support surface once they are placed in position without the need for separately applied adhesives. However, the surface covering elements are preferably readily displaceable vertically away from the support surface to facilitate replacement or repositioning during installation. In accordance with potentially preferred constructions, the

friction enhancing coating is of a nature to facilitate the ability to lift and move the surface covering element to various positions across the support surface a number of times without damaging either the surface covering element or the support surface. In addition, covering elements can be removed or replaced at an extended time after installation. The friction enhancing coating disposed across the backing is preferably of a character which does not permanently bond to the support surface. In addition, the friction enhancing coating does not permanently stick to itself so as to avoid undesired blocking attachment in back to back packaging. Still further, the friction enhancing coating does not adhere to the show surface of the surface covering element so as to avoid undesired permanent adhesion if the surface covering elements are stored in roll form or stacked face to back. That is, the friction enhancing coating provides lateral grip with little vertical stick and with little or no blocking to itself or the face of the surface covering element.

It is to be understood that in any of the constructions as may be used, it is contemplated that the friction enhancing coating 180 may be applied either in partial or complete covering relation to the backing so as to provide the desired level of friction with the support surface. In this regard it is contemplated that the friction enhancing coating may be applied in various patterns such that coated and uncoated regions are cooperatively dispersed across the underside of the surface covering element. By way of example only, various exemplary patterns include widthwise strips (FIG. 32); lengthwise strips (FIG. 33); dots or circles (FIG. 34); cross-hatching arrangements (FIG. 35); and serpentine stripes (FIG. 35). Of course, any other pattern may likewise be used.

The present invention may be further understood through reference to the following nonlimiting examples

EXAMPLES 1-6

The evaluation of various friction enhancing coating materials was carried out by conducting sliding friction and blocking tests in accordance with the following procedures. Each of the tests was carried out on samples of carpet tile having a construction substantially as set forth in Table 6 below.

Table 6

	(A)	(B)
1.	Product Type:	Residential Modular Floor Covering
2.	Face:	High Twist Frieze Cut pile
3.	Primary Backing:	Enhanced backing of woven polypropylene with needled and calendared polyester and low melt polyester
4.	Total Finished Yarn Weight:	39 oz/yd²
5.	Stitches Per Inch:	7.69
6.	Tufting Gauge:	1/8
7.	Yarn Polymer:	Nylon 6,6
8.	Yarn Type:	1180 filament, with antistat, semi dull trilobal, 17 dpf
9.	Yarn Twist:	7.50 twist per inch in singles (S) and ply (Z)
10.	Yarn Ply:	2 ply twisted
11.	Heatset:	Yes, @ 260 to 264 °F with steam frieze
12.	Yarn Size:	3.69/2 cotton count
13.	Tufted Pile Height:	48/64 inches (3/4")
14.	Dyeing Method	Jet Dye
15.	Precoat Adhesive:	Styrene Butadiene Latex, 8 oz/yd² coating weight
16.	Lamination Tiecoat Adhesive:	Hotmelt with a bitumen and polypropylene resin base,
17.	Tiecoat Coating Weight:	46 oz/yd²
18.	Stabilizing Reinforcement:	Fiberglass Mat, 2 oz/yd², modified acrylic binder
19.	Flame Lamination	Fiberglass mat flame laminated to foam
20.	Cushion Type:	Rebond polyurethane foam, 15 millimeter uncompressed chip size
21.	Cushion Thickness	7 – 8 millimeter (prelamination)
22.	Cushion Density	6 lbs/ft³

23.	Flame Lamination	Felt flame laminated to foam
24.	Release Layer construction:	Nonwoven felt
25.	Release Layer composition	70% polyester/ 30% polypropylene blend
26.	Release Layer weight:	4 oz/yd²
27.	Modular Shape:	18" square or nominal 23" x 23" two-side double chevron
28.	Modular Size:	18" square or nominal 23" x 23"
29.	Cutting Method:	Controlled Depth cut from the back

Friction tests were performed by placing a 3" x 3" piece of coated carpet tile having a mass of about 22-24 grams on a smooth flat surface (a piece of laminate wood-like flooring). One end of the flat surface was raised at a rate of ~10 degrees per second. The center of the carpet tile was always placed 10 inches from the pivot point. The angle at which the carpet tile began to slip was recorded . No weight or pressure was applied to the sample, and both surfaces were visually inspected to be clean before the measurement was performed. Error bars are 5 degrees.

Instantaneous blocking tests were performed by placing two identically coated 3" x 3" carpet tiles back-to-back with a 5 pound mass weight applied for 1 minute. A strip of aluminum foil was used to mask ½ inch of one edge. The force required to pull the samples apart was measured using an AccuForce III force meter from AMETEK. The samples were pulled apart by pulling on the edge carpet tufts from the masked side of the tiles.

Elevated temperature blocking tests at 70 degrees C (158 degrees F) were performed by placing two identically coated 3" x 3" carpet tiles back-to-back with a 6.25 lb weight applied for at least 16 hours in a 70 C oven. A strip of aluminum foil was used to mask ½ inch of one edge. After removing from the oven, samples were allowed to cool. They were pulled apart by pulling on the edge carpet tufts from the masked side of the tiles using an AccuForce III force meter from AMETEK. The peak force needed to separate the tiles was recorded.

Re-Stick friction tests were conducted to determine the reusability of the carpet friction enhancing or grip layer. A 3" x 3" piece of coated carpet was placed on clean, laminate, wood-like flooring with a 5-lb weight applied. After 30 seconds, the weight and carpet were moved to a fresh section of the flooring. This was repeated such that the carpet was exposed to 5 positions. The results of a friction test as described above were then recorded.

Pressure sensitive friction tests were performed by placing a 5 lb weight on a 3" x 3" piece of coated carpet on glass for 30 seconds. After removal of the weight, an inclined plane friction test was performed.

Adhesion to glass tests were measured using an AccuForce III force meter from Ametek. A 5-lb weight was applied to 3" x 3" back-coated carpet samples on glass for 30 seconds. The peak force required to remove the sample from the glass by pulling on the edge was recorded.

Results are set forth in table 7 below.

Table 7

Sample	Dry add-on (gsm)	Instantaneous Blocking (lbs)	70 deg C Blocking (lbs)	Friction on Laminate (degrees)	Re-Stick Friction (degrees)	Glass Friction (degrees)	Press. Sensitive Friction	Re-Stick Friction On Glass	Glass Adhesion (lbs)
Latex 1	30	<0.7	< 0.7	85	80	>90	>90	>90	0.4
Latex 2	20	0.7	1.3	48	45	48	>90	50	0.4
Latex 3	30		4.8	60		58	85	60	0
Hot Melt 1	20	<0.7	2.7	45	45	45	50	50	0
Hot Melt 2	45	<0.7	1.5	45		62	>90	65	0.2
Hot Melt 3	35	<0.7	0.9	58		80	>90	>90	0.3
Control	0	<0.7	< 0.7	20	20	20	20	20	0

All carpet samples (3" x 3") weighed 22-24 g.

Latex 1 = National Starch & Chemical Multilock 454A

Latex 2=Rohm and Haas Robond PS-68

Latex 3= Air Products Airflex TL12

Hot Melt 1 = HB Fuller, HL 6102

Hot Melt 2 = HB Fuller, HL 5062

Hot Melt 3 = The Reynolds Company, Reynco 53-343

Based upon these tests it was concluded that Latex 1, Latex 2, Hot Melt 2 and Hot Melt 3 exhibited desirable friction and anti-blocking characteristics with Latex 3 and hot melt 1 being less desirable. More specifically, samples with elevated temperature blocking less than about 3 lbs in combination with substantial sliding friction were believed to be desirable. Samples such as hot melt 2 which exhibit substantial increases in sliding friction following pressure application may be particularly desirable. Of course, the samples tested are merely representative and other suitable coating materials no doubt exist. Exemplary materials may include various classes of latex including acrylics, EVA, SBR, and the like and hot melt materials including polyolefins, EVA, SBR, polyamides, and the like. Potentially preferred coating materials may include latex or olefin based hot melt materials such as olefins based on polypropylene and/or polyethylene and potentially including low molecular weight waxes and tackifiers.. The dry add-on ranges should preferably be about 0.25 to about 3 ounces per square yard and more preferably about 0.5 to about 1.5 ounces per square yard.

The friction enhancing coatings may be applied to the back of the surface covering elements by various methods including roll coating, spray coating, impregnation, powder coating, and printing methods. After application of the coating, a drying and or curing process may be used depending on the form of the coating chosen. Coating may be either continuous or patterned across the underside of the surface covering element.

EXAMPLES 7 AND 8

A carpet construction as set forth in Table 6 above was tested for vertical stick and resistance to lateral movement relative to various underlying support surfaces. Tests were conducted with a bare felt backing and with a friction enhancing coating of a hot melt material marketed by H.B. Fuller Company under

the trade designation HL 5062 applied across a felt backing at a coating weight of 1.0 ounces per square yard.

Vertical adhesion measurements were made using a 6.75 inch X 6.75 inch piece of coated carpet tile placed on each designated surface. A 25 pound weight was placed on top of each sample to insure uniform contact with the surface. After 30 seconds the weight was removed and the sample was grabbed at yarns in the middle and lifted away from the surface. The peak force required to separate the tile sample from the surface was measured using a Shimpo FGE-100X Digital Force Gauge. The measurement was repeated 10 times and the average force value was recorded.

Resistance to lateral movement measurements were made using an 18 inch X 18 inch piece of coated carpet tile placed on each designated surface. An 8.5 pound aluminum plate with an arrangement of downwardly projecting pile engaging pins was placed on top of each sample to ensure uniform contact with the surface. The peak force required to move the tile sample laterally across the surface for a distance of 1 inch was measured using a Model STE-1000 Testron Tensile Tester. The measurement was repeated 10 times and the average force value was recorded.

The results are set forth in Tables 8 and 9 below.

TABLE 8 (Coated Cushion Backed Samples)

Direction	Units	Wood Support	Sealed Concrete Support	Glass Support	Plywood Support	Unsealed Concrete Support
Vertical Adhesion	Lbs.-Total	1.490	1.180	0.550	0.590	0.44
	Lbs./Inch^2	0.033	0.026	0.012	0.013	0.010
Resistance to Lateral Movement	Lbs.-Total	37.2	22.2	30.8	19.2	10.8
	Lbs./Inch^2	0.115	0.069	0.095	0.059	0.033

TABLE 9 (Uncoated Cushion Backed Control Samples)

Direction	Units	Sealed Concrete Support	Glass Support
Vertical Adhesion	Lbs.-Total	0.310	0.300
	Lbs./$Inch^2$	0.007	0.007
Resistance to Lateral Movement	Lbs.-Total	1.1	2.69
	Lbs./$Inch^2$	0.003	0.028

EXAMPLES 9-22

The test procedures of Examples 7 and 8 were carried out on carpet tile samples using other hot melt coatings. Comparison tests were made for each coating using several different coating weights ranging from 1.0 to 2.5 ounces per square yard. Performance using different types of felt backings (T1 felt versus T2 felt) was also evaluated. The results are set forth in Table 10 below:

Table 10 COMPARISONS OF HOT MELT ADHESIVES AND FELTS

Product	Dry Add-On (oz/sq yard)	Type Backing	Shear Strength (lbs/ 18" square)	Shear Strength (lbs/ $inch^2$)	Tensile Strength (lbs/ $inch^2$)
Reynolds 53-451 A	1.0	Felt – T1	9.0	0.028	<0.03
Reynolds 53-451 A	1.6	Felt – T1	8.9	0.027	<0.03
Reynolds 53-451 B	1.0	Felt – T1	15.3	0.047	<0.03
Reynolds 53-451 B	1.5	Felt – T1	11.4	0.035	<0.03
Reynolds 53-451 B	2.5	Felt – T1	12.1	0.037	<0.03
Reynolds 53-451 C	1.0	Felt – T1	17.4	0.054	<0.03
Reynolds 53-451 C	1.5	Felt – T1	14.3	0.044	<0.03
Reynolds 53-451 D	1.0	Felt – T1	9.8	0.030	<0.03
Reynolds 53-451 D	1.5	Felt – T1	9.5	0.029	<0.03
Reynolds 53-451 D	2.5	Felt – T1	9.6	0.030	<0.03

H.B, Fuller 5062	1.0	Felt – T2	22.2	0.069	<0.03
H.B. Fuller 5062	1.5	Felt – T2	19.8	0.061	<0.03
Reynolds 53-451 C	1.0	Felt – T2	44.3	0.136	<0.03
Reynolds 53-451 C	1.5	Felt – T2	43.2	0.133	<0.03

Measurements taken at 74 °F and 50% R.H. Coating Weight = 1.0 oz/sq-yard
Surface = Sealed (Smooth) Concrete Surface

In each example, coated tiles did not permanently bond to common sub-floor surfaces. Coated tiles exhibited sufficiently high resistance to lateral movement to prevent the tile from easily sliding and also exhibited low vertical adhesive properties (tack) that allowed tiles to easily be lifted from place.

In particular, it was concluded that a hot melt coating material under the trade designation Reynolds 53-451C, comprised essentially of a mixture of polypropylene, polyethylene and selected tackifying agents that have a high propensity to wet concrete surfaces, exhibited significantly higher resistance to lateral tile movement for concrete surfaces than other tested products.

Further, the above tests demonstrate that the nature of the felt backing to which the coating is applied may improve the performance of these coatings in terms of their resistance to lateral movement (shear strength) with no corresponding change in vertical adhesion (shear strength). In particular, it was found that so called “type T2” felt provided superior resistance to lateral movement with the same coating addition. By T2 felt is meant felt that is predrafted and elliptically needled.

The type T2 felt in the above examples is formed by needling a predrafted fibrous web of about 60% polyester fibers having a linear density of about 4 denier and a staple length of about 3 inches and about 40% polypropylene fibers having a linear density of about 5 denier and a staple length of about 4 inches using three needling machines incorporating elliptical needle movement. More specifically,

the blend of fibers (60% polyester and 40% polypropylene) is subjected to a drafting operation as will be well known to those of skill in the art prior to needling which aligns and stretches the fibers such that the web exiting the drafting station is about 1.8 times the length of the web entering the drafting station. It is believed that the comparative type T1 felt (available from Synthetic Industries in Dalton Georgia, USA) utilizes the same fibrous blend but without a drafting treatment prior to needling.

The type T2 felt is passed through three needling machines which utilize elliptical needle movement. The comparative type T1 felt is formed at two needling machines which use a straight reciprocating motion. In the formation of the type T2 felt the elliptical needling machines permit the needles to move with the web at substantially the same speed as the web while nonetheless penetrating the web to entangle the fibers. Conversely, in the straight reciprocating motion used to form the type T2 felt, the needles do not move in the direction of the web.

According to one contemplated practice in forming the type T2 felt, the first needling machine utilizes about 3857 needles per meter per board mounted on four boards disposed above and below the travel path of the web and which move in elliptical travel paths so as to cause the outwardly projecting needles to penetrate and withdraw from the web so as to cause entanglement and web densification. The needles in the first needling machine are preferably 40 gauge triangle needles. The second and third needling machines also incorporate 3857 needles per meter per board but use only the top two boards (i.e. the boards disposed above the web). The needles in the second needling machine are 38 gauge star needles and the needles in the third needling machine are 42 gauge triangle needles. In formation of the comparative type T2 felt the first needling machine uses 5000 needles up and 7000 needles down while the second needling machine uses 7000 needles up and 7000 needles down.

Although the precise mechanism which causes the type T2 felt to exhibit improved performance is not fully understood, it is believed that the predrafting of the fibrous

web prior to needling in combination with the elliptical needling entanglement may provide a higher surface area for attachment of the coating material. Thus, the coating is deposited across a complex matrix structure. This avoids film formation, on the contact surface thereby maintaining an irregular high surface area for contact with the floor or other underlying structure. Thus, the improved performance is understood to result from the higher surface area and the fact that the coating material may be concentrated within the high surface area fiber matrix.

In various carpeting structures as described above, the predrafting in combination with elliptical needling entanglement also serves to form a structure which is more resistant to penetration from the top by the urethane or other overlying material. This avoids a situation in which the urethane or other material seals the felt. Such sealing may promote undesirable film formation when the friction enhancing coating is applied. Thus, by reducing penetration from the overlying urethane or other material, the desired high contact surface is promoted.

EXAMPLES 23-26 (COMPARATIVE)

Using the test procedures of Examples 7 and 8 comparison tests were made comparing shear strength (i.e. resistance to lateral movement) of friction enhancing coating Reynolds 53-451C relative to prior art modular adhesive techniques of applying pressure sensitive releasable adhesives to an underlying floor prior to installing an overlying carpet tile and so called "*Peel & Stick*" techniques wherein pressure sensitive adhesives are applied to the back surface during manufacturing with an overlying protective plastic film to prevent tiles from sticking together prior to installation. The results are set forth in the following table.

	Shear Strength (lbs/ inch^2)	**Tensile Strength (lbs/ inch^2)**	**Shear Strength (lbs/ 18" square)**
Milliken Modular Adhesive	0.324	0.066	105.0
Shaw Carpet– Peel & Stick	0.164	0.182	53.3
C&S Carpet – Peel & Stick	0.152	0.090	49.1
Reynolds 53-451 C	0.136	<0.030	44.3

Measurements taken at 74 °F and 50% R.H.
Surface = Sealed (Smooth) Concrete Surface
Tests for Reynolds 53-451C were made using T-2 felt made at the Alma plant. Coating Weight = 1.0 oz/sq-yard

Based on the above tests, it was concluded that hot melt coatings, like or similar to Reynolds product 53-451C, when applied to specific types of felt carpet tile backings, exhibit high shear strengths equivalent to prior art methods as manufacturer applied adhesives (Peel & Stick) with lower vertical adhesion properties.

The following benefits and advantages are contemplated for the above mentioned coatings, in particular in the context of 36 inch cushion carpet tile products.

1. Carpet tile products requiring no wet adhesive for installation, either applied to the under lying floor prior to overlaying carpet tile or as pressure sensitive adhesive applied during the manufacturing process with an overlying protective plastic film are provided.

2. Carpet tile products with high shear strength for preventing slippage between the floor covering and low tensile strength to facilitate removal and replacement of the floor covering are provided without the need for an overlying protective plastic release film that must be removed prior installing the tile. Such character lends to the elimination of packaging waste and cost for the same.

3. Carpet tile products that can be installed over concrete surfaces with moisture levels up to 8.0 lbs/1000 sq ft/ 24 hours, based on the industry standard calcium chloride test, that exceeds the current acknowledged industry standard of 3.0 lbs/1000 sq ft/24 hours are provided.

4. Carpet tile products that can be installed over most old (non-solvent based) adhesives with residual tack levels =/< 0.20-lbs/sq inch without extensive floor preparation to sand, remove or seal over such adhesives are

provided.

EXAMPLES 27 AND 28 (Hard Backed Carpet)

Vertical adhesion and resistance to lateral movement were measured for tufted and bonded hard backed carpet constructions relative to a glass surface using the procedures outlined with respect to Examples 7 and 8 above.

The bonded carpet construction was substantially as illustrated in FIG. 23D with a pile face of nylon yarn (about 29 ounces per square yard), a bonding layer of PVC (about 60 ounces per square yard), a primary backing layer of glass (about 3 ounces per square yard), and an underlying supporting sandwich structure of glass (about 3 ounces per square yard) between two layers of PVC having a combined mass of about 80 ounces per square yard. In the coated specimen a friction enhancing coating of HB Fuller, HL 5062 (olefin hot melt) was coated across the lower PVC surface at a level of about 1.2 ounces per square yard.

The tufted carpet construction was substantially as illustrated in FIG. 23A with a pile face of nylon yarn (about 24 ounces per square yard), a primary backing of spunbonded polyester, a layer of latex precoat ((about 16 ounces per square yard), and a sandwich structure of glass (about 3 ounces per square yard) between two layers of PVC having a combined mass of about 60 ounces per square yard. In the coated specimen a friction enhancing coating of HB Fuller, HL 5062 hot melt was coated across the lower PVC surface at a level of about 1.2 ounces per square yard.

The results are set forth in Table 11.

TABLE 11 (Hard-Back Carpet Tile on Glass)

Direction	Units	Uncoated Bonded	Bonded Carpet (Coated)	Tufted Carpet (Coated)
Vertical Adhesion	Lbs.-Total	0.280	0.300	0.300
	Lbs./Inch^2	0.007	0.007	0.007
Resistance to Lateral Movement	Lbs.-Total	2.69	39.6	37.8
	Lbs./Inch^2	0.008	0.122	0.117

While excellent results were achieved using the olefin hot melt coating across the PVC, it is contemplated that latex or other water based adhesives may provide substantial benefits in such applications.

EXAMPLES 29- 32 (Non-Carpet Tile Materials)

The following examples exhibit lateral grip, optional bond cleavage strength and low back to back adhesion of various non-carpet surface covering materials in both coated and uncoated conditions.

A friction enhancing olefin based hot melt coating, H.B. Fuller HL 5062, was applied to common hard surface materials using a top roll applicator. The friction enhancing properties were then evaluated by measuring the resistance to lateral movement (bond shear strength) and vertical adhesion (bond cleavage strength) of each sample using a glass surface according to the procedures described below. Additional measurements were made to determine the adhesion between two coated samples after the coated surfaces were placed in contact.

Cleavage adhesion measurements were made using pieces of coated hard surface materials placed on a glass surface. Each sample overlapped the glass surface, a distance of 1", thereby providing a surface against which a force could be applied to separate the sample from the glass surface and measure the result cleavage force. A 25 lb weight was placed on top of each sample to insure

uniform contact with the surface. After 30 seconds, the weight was removed and the peak force required to separate the sample from the surface measured using a Shimpo FGE-100X Digital Force Gauge. In each case, the separating force was applied pushing up on the overlap lip perpendicular (90^o +/- 5^o) to the tested sample. The measurement was repeated 5 times and the average force value then recorded. Measurement were made for control samples (uncoated) using the same method and then compared to the coated materials.

Resistance to lateral movement measurements were made using pieces of coated hard surface materials placed on a glass surface. A 25 lb weight was placed on top of each sample to insure uniform contact with the surface. After 30 seconds, the weight was removed and the peak force required to move or push the sample laterally across the glass surface measured using a Shimpo FGE-100X Digital Force Gauge. In each case, the force was applied as a pushing force to the center edge of the sample with a downward an angle of 25 ^{o} +/- 5^o. The measurement was repeated 5 times and the average force value then recorded. Measurement were made for control samples (uncoated) using the same method and then compared to the coated materials.

Adhesion between samples was measured by placing two pieces of coated hard surface materials with their respective coated surfaces in contact so as to evaluate blocking character. The samples were overlapped, a distance of 1 inch relative to one another thereby providing a surface against which a force would be applied to separate the samples. A 25 lb weight was placed on top of the sample and removed after 30 seconds. The force required to separate the samples was measured using a Shimpo FGE-100X Digital Force Gauge. In each case , the separating force was applied along the overlap lip perpendicular (90^o +/- 5^o) to the tested sample. The measurement was repeated 5 times and the average force value then recorded.

The results are set forth at tables 12 (coated samples) and 13 (uncoated control samples) below.

TABLE 12: MEASUREMENTS OF HARD SURFACE MATERIALS - COATED

	Units	Vinyl Tile	Ceramic Tile	Laminate Flooring	Wood Flooring
Horizontal Bond	Lbs - Total	32.4	28.1	>100.0	>100.0
	Lbs-Inch^2	0.225	0.781	> 1.667	> 0.790
Cleavage Bond	Lbs - Total	1.60	0.60	1.50	1.70
	Lbs-Inch Width	0.133	0.100	0.188	0.151
Adhesion	Lbs - Total	1.80	1.70	1.10	1.70
	Lbs-Inch Width	0.150	0.283	0.138	0.151
Sample Size	Inches	12 x 12	6.0 x 6.0	8 x 7 ½	11 ¼ x 11 ¼
Sample Weight	Gms	635	267	286	686
Dry Add On	Gms/ Sq Foot	4.0	8.0	9.5	4.6

Measurements taken at 72 °F and 50% R.H. Product = H.B. Fuller 5062

PRODUCT 1 - STANDARD VINYL COMPOSITION TILE – ARMSTRONG
PRODUCT 2 - STANDARD CERAMIC WALL TILE – IMGERA – B12-156
PRODUCT 3 - LAIMINATED WOOD COMPOSITE FLOOR – SHAW LAMINATES – 100-469
PRODUCT 4 - PREGO WOOD FLOORING WITH ATTACHED CUSHION BACK

TABLE 13: MEASUREMENTS OF HARD SURFACE MATERIALS - CONTROLS

	Units	Vinyl Tile	Ceramic Tile	Laminate Flooring	Wood Flooring
Horizontal Bond	Lbs - Total	0.55	0.30	0.50	1.30
	Lbs-Inch^2	0.046	0.050	0.063	0.116
Cleavage Bond	Lbs - Total	1.0	0.30	0.70	0.90
	Lbs-Inch Width	0.083	0.050	0.088	0.080

EXAMPLES 33- 40 (PVC BACKED CARPET TILE)

In order to evaluated suitability of various friction enhancing coatings for use on PVC hardback carpet tiles, chemical compatibility with PVC backings under accelerated aging conditions was measured for a number of friction-enhancing coating compositions. Chemical compatibility for various friction-enhancing coatings was evaluated using accelerated aging to measure the effects of the aging process for coatings applied across a PVC backed carpet tile using a standard PVC backed primary carpet tile Style GA-100 from Toli Japan having a construction substantially as illustrated and described in relation to FIG. 23F with a total weight of 1320 gms/sq meter. These tests indicate whether or not the

friction-enhancing coating is adversely affected due to the migration of plasticizers or additive chemicals from the PVC carpet tile body into the adjoining coating over time. Undesirable migration is designated by an "F" while lack of migration is designated by a "P"

Test material was prepared by applying each friction-enhancing coating to the back surface of the PVC backed carpet tile using a conventional top roll applicator. As applicable, some samples received post treatment, either UV curing or drying, necessary to chemically cross-link the base polymer. Details are provided in Table 14, which lists and describes each product evaluated. Coating weights ranged from 1.0 to 1.5 oz/ sq yard (3.2 – 4.7 gms/sq foot), resulting in a coating thickness of 1.5 – 2.5 mils.

In order to reflect a range of actual long term uses, two different accelerated aging tests were utilized as outlined below.

<u>Accelerated Aging Test #1</u>

1. Coated PVC backed carpet tile were cut into 4"x 4" test squares. Three samples sets were prepared for each coating material by placing two (2) carpet squares back to back. A two (2) Kilogram weight was placed on top of each sample set.

2. Each sample set was placed in a conventional laboratory oven maintained at 160° F.

3. Individual sample sets were removed from the oven at intervals of 24, 48 and 72 hours and inspected for evidence of chemical reactions or bonding between the individual layers due to plasticizer or additive migration. Friction properties were evaluated by conducting slide friction tests across various surfaces.

<u>Accelerated Aging Test #2</u>

1. Coated PVC backed carpet tile were cut into 4"x 4" test squares. Sample sets were prepared placing two (2) carpet squares back to back. A two (2) Kilogram weight was placed on top of each sample set.

2. Each sample set was placed in a conventional laboratory oven maintained at 120° F. for a period of twenty-one days.

3. The samples sets were inspected for evidence of chemical reactions or bonding between the individual layers due to plasticizer or additive migration. Friction properties were evaluated by conducting a slide friction test.

Thus, Test #1 was conducted at a higher temperature for shorter periods of time, while Test #2 was conducted at a lower temperature for a longer period of time. The results are summarized in Table 13 below. A passing result was achieved if there was no indication of chemical reaction or change in coating properties following the test. Conversely, a visible indication of chemical reaction and/or change in coating properties resulted in a failing result.

Based on these tests it was concluded that several modified or cross-linked urethane coatings exhibited excellent resistance to PVC plasticizers and additive reactions. Likewise, certain acrylate hot melt compounds exhibited excellent resistance to PVC plasticizers and additive reaction.

TABLE 14 CHEMICAL COMPATIBILITY WITH PVC BACKED CARPET TILE

				ACCELERATED AGING			
PRODUCT	COMPOUND BASE	POST TREATMENT	ADD-ON	24 HR	48 HR	72 HR	21 DAY
H.B. FULLER 5062	POLYOLEFIN POLYMERS	HOT MELT - NONE	1.0	F	F	F	F
NORTHWEST 50587G	CROSS-LINK URETHANE	UV CURED	1.1	P	P	P	P
NORTHWEST 50587H	CROSS-LINK URETHANE	UV CURED	1.0	P	P	P	P
CTI 3603	CROSS-LINK URETHANE	FORCED AIR OVEN	1.0	P	P	P	P
ROBOND PS-68	ACRYLIC POLYMERS	FORCED AIR OVEN	1.2	F	F	F	F
CTI 2743	ACRYLIC POLYMERS	FORCED AIR OVEN	1.2	F	F	F	F
REYNOLDS 531 C	POLYOLEFIN POLYMERS	HOT MELT - NONE	1.0	F	F	F	F
H.B. FULLER 6599	ACRYLATE POLYMERS	HOT MELT - NONE	1.1	P	P	P	P

H.B. Fuller 5062 and 6599 -- Available from H.B. Fuller Co.;

Northwest 50587G and 50587H -- Available from Northwest Coatings in Oak Creek Wisconsin;

CTI 3603 and 2743 – Available from Chemical Technologies Inc. in Detroit Michigan;

Robond PS-68 -- Available from Rohm and Haas Chemicals;

Reynolds 531 C – Available from The Reynolds Company;

EXAMPLES 41-48

Friction enhancing properties for various coatings showing chemical compatibility with PVC (i.e. those that passed the ageing tests above) were measured across various flooring surfaces (concrete, wood, glass, aluminum and steel) and compared to a Toli GA-100 PVC hard backed tile without a friction enhancing coating. Vertical stick of the coated tiles and an uncoated control sample on these surfaces was also measured. The testing procedures utilized for measuring friction and vertical stick as set forth in Examples 7 and 8 above were utilized. The results are set forth in Table 15 below.

TABLE 15

PRODUCT		UNITS	CONCRETE	WOOD	GLASS	ALUMINUM	STEEL
LATERAL RESISTANCE							
NORTHWEST 50587G	1.1 OZ / YD^2	lbs/ 18" sq	15.1	20.5	21.6	19.4	17.3
		lbs/ inch^2	0.047	0.063	0.067	0.060	0.053
CTI 3603	1.2 OZ / YD^2	lbs/ 18" sq	31.8	33.3	31.5	33.0	21.8
		lbs/ inch^2	0.098	0.103	0.097	0.102	0.067
H.B. FULLER 6599	1.2 OZ / YD^2	lbs/ 18" sq	20.6	21.9	15.8	46.0	22.8
		lbs/ inch^2	0.064	0.068	0.049	0.142	0.070
CONTROL		lbs/ 18" sq	12.7	12.3	12.3	13.3	10.7
		lbs/ inch^2	0.039	0.038	0.038	0.041	0.033
VERTICAL ADHESION							
NORTHWEST 50587G	1.1 OZ / YD^2	lbs/ 6.75" sq	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
		lbs/ inch^2	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
CTI 3603	1.2 OZ / YD^2	lbs/ 6.75" sq	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
		lbs/ inch^2	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
H.B. FULLER 6599	1.2 OZ / YD^2	lbs/ 6.75" sq	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
		lbs/ inch^2	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
CONTROL		lbs/ 6.75" sq	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
		lbs/ inch^2	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007

Based on the above tests, it was concluded that the coatings listed in Table 15 exhibited desirable properties, such that coated tiles did not permanently bond to common sub-floor surfaces while nonetheless exhibiting sufficiently high resistance to lateral movement to prevent the tile from easily sliding or moving. Further, the coating exhibited low vertical adhesive properties (tack), desirable properties that allow the tile to easily be lifted from place.

Of course, it is to be understood that such friction enhancing coatings are in no way limited to hardback PVC carpet tile. Rather, it is contemplated that such friction enhancing coatings may be used with any cushioned or hardback carpet tile as well as with other non-carpet surface coverings as described herein. The present invention thus provides numerous surface covering elements which incorporate a friction enhancing coating across a lower surface. Surprisingly, it

has been found that such friction enhancing coatings may provide desired resistance to lateral slip while nonetheless avoiding a high degree of vertical stick to the underlying support surface (such as a floor, counter top, wall, etc.). This resistance to vertical stick aids in replacement of the covering elements following installation while also avoiding the need to incorporate a peel away covering sheet for packaging installation. The friction enhancing coating also is characterized by low adherence to itself (i.e. it is substantially non-blocking) thereby permitting back to back packaging. Moreover, coatings have been identified which are fully compatible with traditional PVC backings as are used in hard backed carpet tile.

Of course, it is to be understood that while the present invention has been illustrated and described in relation to potentially preferred embodiments, constructions and practices, that such embodiments, constructions and practices are intended to be illustrative only and that the invention is in no event to be limited thereto. Rather, it is contemplated that modifications and variations embodying the principles of the present invention will no doubt occur to those of skill in the art and it is therefore contemplated and intended that the present invention will extend to all such modifications and variations as may incorporate the broad principles of the present invention.